MATH240: Undetermined Coefficients

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Name: _____ Date: _____ Score: / 30

Learning Objectives

- Calculate the mean, median, mode, and range of a data set
- Compute sample variance and standard deviation
- Construct quartiles, the IQR, and identify outliers
- Describe the shape, center, and spread of a distribution

Simplify each expression completely. Show all steps and circle your final answer.

Particular solution — constant forcing

1. Find a particular solution yp for y'' + 6y' + 1y = 2.

$$y'' + 6y' + 1y = 2$$

Answer: _____

2. A spring with damping satisfies y'' + 2y' + 4y = 8 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 2y' + 4y = 8$$

Answer: _____

3. Find the steady-state (particular) solution of y'' + 4y' + 7y = 20.

$$y'' + 4y' + 7y = 20$$

Answer: _____

4. Find a particular solution yp for y'' + 3y' + 4y = 17.

$$y'' + 3y' + 4y = 17$$

Answer: _____

5. A spring with damping satisfies y'' + 2y' + 5y = 5 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 2y' + 5y = 5$$

Answer: _____

6. Find the steady-state (particular) solution of y'' + 3y' + 3y = 16.

$$y'' + 3y' + 3y = 16$$

Answer: _____

7. Find a particular solution yp for y'' + 5y' + 3y = 6.

$$y'' + 5y' + 3y = 6$$

Answer: _____

8. A spring with damping satisfies y'' + 2y' + 4y = 17 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 2y' + 4y = 17$$

Answer: _____

9. Find the steady-state (particular) solution of y'' + 4y' + 9y = 11.

$$y'' + 4y' + 9y = 11$$

Answer: _____

10. Find a particular solution yp for y'' + 2y' + 5y = 19.

$$y'' + 2y' + 5y = 19$$

Answer: _____

11. A spring with damping satisfies y'' + 4y' + 2y = 20 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 4y' + 2y = 20$$

Answer: _____

12. Find the steady-state (particular) solution of y'' + 5y' + 9y = 9.

$$y'' + 5y' + 9y = 9$$

Answer: _____

13. Find a particular solution yp for y'' + 2y' + 4y = 19.

$$y'' + 2y' + 4y = 19$$

Answer: _____

14. A spring with damping satisfies y'' + 2y' + 3y = 8 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 2y' + 3y = 8$$

Answer: _____

15. Find the steady-state (particular) solution of y'' + 5y' + 3y = 18.

$$y'' + 5y' + 3y = 18$$

Answer: _____

16. Find a particular solution yp for y'' + 1y' + 3y = 20.

$$y'' + 1y' + 3y = 20$$

Answer: _____

17. A spring with damping satisfies y'' + 6y' + 3y = 10 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 6y' + 3y = 10$$

Answer: _____

18. Find the steady-state (particular) solution of y'' + 2y' + 3y = 23.

$$y'' + 2y' + 3y = 23$$

Answer: _____

19. Find a particular solution yp for y'' + 3y' + 3y = 20.

$$y'' + 3y' + 3y = 20$$

Answer: _____

20. A spring with damping satisfies y'' + 5y' + 3y = 21 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 5y' + 3y = 21$$

Answer: _____

21. Find the steady-state (particular) solution of y'' + 5y' + 4y = 5.

$$y'' + 5y' + 4y = 5$$

Answer: _____

22. Find a particular solution yp for y'' + 4y' + 4y = 11.

$$y'' + 4y' + 4y = 11$$

Answer: _____

23. A spring with damping satisfies y'' + 5y' + 2y = 24 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 5y' + 2y = 24$$

Answer: _____

24. Find the steady-state (particular) solution of y'' + 4y' + 5y = 12.

$$y'' + 4y' + 5y = 12$$

Answer: _____

25. Find a particular solution yp for y'' + 1y' + 3y = 15.

$$y'' + 1y' + 3y = 15$$

Answer: _____

26. A spring with damping satisfies y'' + 2y' + 2y = 17 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 2y' + 2y = 17$$

Answer: _____

27. Find the steady-state (particular) solution of y'' + 4y' + 8y = 26.

$$y'' + 4y' + 8y = 26$$

Answer: _____

28. Find a particular solution yp for y'' + 6y' + 1y = 5.

$$y'' + 6y' + 1y = 5$$

Answer: _____

29. A spring with damping satisfies y'' + 2y' + 4y = 18 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 2y' + 4y = 18$$

Answer: _____

30. Find the steady-state (particular) solution of y'' + 3y' + 7y = 22.

$$y'' + 3y' + 7y = 22$$

Answer: _____

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ANSWER KEY & SOLUTIONS

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Topics: Particular solution — constant forcing. All answers verified by independent computation.

Solutions

Particular solution — constant forcing

1. Find a particular solution yp for y'' + 6y' + 1y = 2.

$$y'' + 6y' + 1y = 2$$

→ *Try yp = A (constant). Substituting into the ODE: 0 + 6·0 + 1·A = 2.*
→ *Solving: A = 2/1 = 2.*
→ *Particular solution: yp = 2.*

Answer: $y_p = 2$

2. A spring with damping satisfies y'' + 2y' + 4y = 8 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 2y' + 4y = 8$$

→ *At equilibrium, y'' = y' = 0. So 4·yp = 8.*
→ *yp = 8/4 = 2.*

Answer: $y_p = 2$

3. Find the steady-state (particular) solution of y'' + 4y' + 7y = 20.

$$y'' + 4y' + 7y = 20$$

→ *For constant forcing f = 20, try yp = A.*
→ *Substituting: 7A = 20, so A = 20/7 = 20/7.*
→ *Steady-state solution: yp = 20/7.*

Answer: $y_p = \frac{20}{7}$

4. Find a particular solution yp for y'' + 3y' + 4y = 17.

$$y'' + 3y' + 4y = 17$$

→ *Try yp = A (constant). Substituting into the ODE: 0 + 3·0 + 4·A = 17.*
→ *Solving: A = 17/4 = 17/4.*
→ *Particular solution: yp = 17/4.*

Answer: $y_p = \frac{17}{4}$

5. A spring with damping satisfies y'' + 2y' + 5y = 5 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 2y' + 5y = 5$$

→ *At equilibrium, y'' = y' = 0. So 5·yp = 5.*
→ *yp = 5/5 = 1.*

Answer: $y_p = 1$

6. Find the steady-state (particular) solution of y'' + 3y' + 3y = 16.

$$y'' + 3y' + 3y = 16$$

→ *For constant forcing f = 16, try yp = A.*
→ *Substituting: 3A = 16, so A = 16/3 = 16/3.*
→ *Steady-state solution: yp = 16/3.*

Answer: $y_p = \frac{16}{3}$

---

7. Find a particular solution yp for y'' + 5y' + 3y = 6.

$$y'' + 5y' + 3y = 6$$

→ *Try yp = A (constant). Substituting into the ODE: 0 + 5·0 + 3·A = 6.*
→ *Solving: A = 6/3 = 2.*
→ *Particular solution: yp = 2.*

Answer: $y_p = 2$

---

8. A spring with damping satisfies y'' + 2y' + 4y = 17 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 2y' + 4y = 17$$

→ *At equilibrium, y'' = y' = 0. So 4·yp = 17.*
→ *yp = 17/4 = 17/4.*

Answer: $y_p = \frac{17}{4}$

---

9. Find the steady-state (particular) solution of y'' + 4y' + 9y = 11.

$$y'' + 4y' + 9y = 11$$

→ *For constant forcing f = 11, try yp = A.*
→ *Substituting: 9A = 11, so A = 11/9 = 11/9.*
→ *Steady-state solution: yp = 11/9.*

Answer: $y_p = \frac{11}{9}$

---

10. Find a particular solution yp for y'' + 2y' + 5y = 19.

$$y'' + 2y' + 5y = 19$$

→ *Try yp = A (constant). Substituting into the ODE: 0 + 2·0 + 5·A = 19.*
→ *Solving: A = 19/5 = 19/5.*
→ *Particular solution: yp = 19/5.*

Answer: $y_p = \frac{19}{5}$

---

11. A spring with damping satisfies y'' + 4y' + 2y = 20 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 4y' + 2y = 20$$

→ *At equilibrium, y'' = y' = 0. So 2·yp = 20.*
→ *yp = 20/2 = 10.*

Answer: $y_p = 10$

---

12. Find the steady-state (particular) solution of y'' + 5y' + 9y = 9.

$$y'' + 5y' + 9y = 9$$

→ *For constant forcing f = 9, try yp = A.*
→ *Substituting: 9A = 9, so A = 9/9 = 1.*
→ *Steady-state solution: yp = 1.*

Answer: $y_p = 1$

---

13. Find a particular solution yp for y'' + 2y' + 4y = 19.

$$y'' + 2y' + 4y = 19$$

→ *Try yp = A (constant). Substituting into the ODE: 0 + 2·0 + 4·A = 19.*
→ *Solving: A = 19/4 = 19/4.*
→ *Particular solution: yp = 19/4.*

Answer: $y_p = \frac{19}{4}$

---

14. A spring with damping satisfies y'' + 2y' + 3y = 8 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 2y' + 3y = 8$$

→ *At equilibrium, y'' = y' = 0. So 3·yp = 8.*
→ *yp = 8/3 = 8/3.*

Answer: $y_p = \frac{8}{3}$

---

15. Find the steady-state (particular) solution of y'' + 5y' + 3y = 18.

$$y'' + 5y' + 3y = 18$$

→ *For constant forcing f = 18, try yp = A.*
→ *Substituting: 3A = 18, so A = 18/3 = 6.*
→ *Steady-state solution: yp = 6.*

Answer: $y_p = 6$

---

16. Find a particular solution yp for y'' + 1y' + 3y = 20.

$$y'' + 1y' + 3y = 20$$

→ *Try yp = A (constant). Substituting into the ODE: 0 + 1·0 + 3·A = 20.*
→ *Solving: A = 20/3 = 20/3.*
→ *Particular solution: yp = 20/3.*

Answer: $y_p = \frac{20}{3}$

---

17. A spring with damping satisfies y'' + 6y' + 3y = 10 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 6y' + 3y = 10$$

→ *At equilibrium, y'' = y' = 0. So 3·yp = 10.*
→ *yp = 10/3 = 10/3.*

Answer: $y_p = \frac{10}{3}$

---

18. Find the steady-state (particular) solution of y'' + 2y' + 3y = 23.

$$y'' + 2y' + 3y = 23$$

→ *For constant forcing f = 23, try yp = A.*
→ *Substituting: 3A = 23, so A = 23/3 = 23/3.*
→ *Steady-state solution: yp = 23/3.*

Answer: $y_p = \frac{23}{3}$

---

19. Find a particular solution yp for y'' + 3y' + 3y = 20.

$$y'' + 3y' + 3y = 20$$

→ *Try yp = A (constant). Substituting into the ODE: 0 + 3·0 + 3·A = 20.*
→ *Solving: A = 20/3 = 20/3.*
→ *Particular solution: yp = 20/3.*

Answer: $y_p = \frac{20}{3}$

---

20. A spring with damping satisfies y'' + 5y' + 3y = 21 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 5y' + 3y = 21$$

→ *At equilibrium, y'' = y' = 0. So 3·yp = 21.*
→ *yp = 21/3 = 7.*

Answer: $y_p = 7$

---

21. Find the steady-state (particular) solution of y'' + 5y' + 4y = 5.

$$y'' + 5y' + 4y = 5$$

→ *For constant forcing f = 5, try yp = A.*
→ *Substituting: 4A = 5, so A = 5/4 = 5/4.*
→ *Steady-state solution: yp = 5/4.*

Answer: $y_p = \frac{5}{4}$

---

22. Find a particular solution yp for y'' + 4y' + 4y = 11.

$$y'' + 4y' + 4y = 11$$

→ *Try yp = A (constant). Substituting into the ODE: 0 + 4·0 + 4·A = 11.*
→ *Solving: A = 11/4 = 11/4.*
→ *Particular solution: yp = 11/4.*

Answer: $y_p = \frac{11}{4}$

---

23. A spring with damping satisfies y'' + 5y' + 2y = 24 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 5y' + 2y = 24$$

→ *At equilibrium, y'' = y' = 0. So 2·yp = 24.*
→ *yp = 24/2 = 12.*

Answer: $y_p = 12$

---

24. Find the steady-state (particular) solution of y'' + 4y' + 5y = 12.

$$y'' + 4y' + 5y = 12$$

→ *For constant forcing f = 12, try yp = A.*
→ *Substituting: 5A = 12, so A = 12/5 = 12/5.*
→ *Steady-state solution: yp = 12/5.*

Answer: $y_p = \frac{12}{5}$

---

25. Find a particular solution yp for y'' + 1y' + 3y = 15.

$$y'' + 1y' + 3y = 15$$

→ *Try yp = A (constant). Substituting into the ODE: 0 + 1·0 + 3·A = 15.*
→ *Solving: A = 15/3 = 5.*
→ *Particular solution: yp = 5.*

Answer: $y_p = 5$

---

26. A spring with damping satisfies y'' + 2y' + 2y = 17 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 2y' + 2y = 17$$

→ *At equilibrium, y'' = y' = 0. So 2·yp = 17.*
→ *yp = 17/2 = 17/2.*

Answer: $y_p = \frac{17}{2}$

---

27. Find the steady-state (particular) solution of y'' + 4y' + 8y = 26.

$$y'' + 4y' + 8y = 26$$

→ *For constant forcing f = 26, try yp = A.*
→ *Substituting: 8A = 26, so A = 26/8 = 13/4.*
→ *Steady-state solution: yp = 13/4.*

Answer: $y_p = \frac{13}{4}$

---

28. Find a particular solution yp for y'' + 6y' + 1y = 5.

$$y'' + 6y' + 1y = 5$$

→ *Try yp = A (constant). Substituting into the ODE: 0 + 6·0 + 1·A = 5.*
→ *Solving: A = 5/1 = 5.*
→ *Particular solution: yp = 5.*

Answer: $y_p = 5$

---

29. A spring with damping satisfies y'' + 2y' + 4y = 18 (constant forcing). Find the equilibrium (particular) solution.

$$y'' + 2y' + 4y = 18$$

→ *At equilibrium, y'' = y' = 0. So 4·yp = 18.*
→ *yp = 18/4 = 9/2.*

Answer: $y_p = \frac{9}{2}$

---

30. Find the steady-state (particular) solution of y'' + 3y' + 7y = 22.

$$y'' + 3y' + 7y = 22$$

→ *For constant forcing f = 22, try yp = A.*
→ *Substituting: 7A = 22, so A = 22/7 = 22/7.*
→ *Steady-state solution: yp = 22/7.*

Answer: $y_p = \frac{22}{7}$